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Artikel Asli/*Original Articles*

Comparison of Physical Performance between Older Adult Fallers with and without Knee Osteoarthritis

(Perbandingan Prestasi Fizikal bagi Warga Emas yang Pernah Jatuh antara Penghidap dan Bukan Penghidap Osteoarthritis Sendi Lutut)

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ABSTRACT

Knee osteoarthritis (OA) is a common musculoskeletal condition that leads to decreased physical performance and falls among older adults. However, there is limited information comparing physical performances among older adult fallers with and without knee OA. The aim of this study was to compare physical performance between older adult fallers with and without knee OA. Participants were divided into two groups using the clinical diagnosis of knee OA based on National Institute of Health and Care Excellence guidelines; with and without knee OA. Participants performed a battery of physical performance tests that included chair sit and reach, back scratch, dominant handgrip strength, timed up and go (TUG), 30 seconds chair stand and 2 min walk. Independent t-test was used to compare physical performance between groups. Thirteen older adult fallers with knee OA (mean age = 70.92 ± 8.83 years) and 20 older adult fallers without knee OA (76.4 ± 7.92 years) participated in this study. There were no significant differences in sociodemographic profiles and physical performance among older adult fallers with and without knee OA ($p > 0.05$). However, hamstring flexibility was not within norm in 64% of older adult fallers with knee OA compared to 42% without OA. Physical performance between fallers with and without clinically diagnosed knee OA was similar. Hence, physiotherapy interventions for both groups may be similar and focused on strength and endurance training. In addition, to minimize falls risk and further improve physical performance, hamstring stretching must be emphasized among older adults with knee OA.

Keywords: Knee osteoarthritis; physical performance; falls; older adults

ABSTRAK

Osteoarthritis (OA) sendi lutut merupakan masalah muskuloskeletal lazim yang menyebabkan penurunan prestasi fizikal dan insiden jatuh dalam kalangan warga emas. Namun demikian, terdapat maklumat yang terhad membandingkan prestasi fizikal dalam kalangan warga emas yang pernah jatuh antara penghidap dan bukan penghidap osteoarthritis (OA) sendi lutut. Tujuan kajian ini adalah untuk membandingkan prestasi fizikal dalam kalangan warga emas yang pernah jatuh antara penghidap dan bukan penghidap OA sendi lutut. Para peserta telah diagihkan kepada dua kumpulan berdasarkan garis panduan diagnosis klinikal OA sendi lutut oleh National Institute of Health and Care Excellence; penghidap dan bukan penghidap OA sendi lutut. Para peserta telah menjalani bateri ujian kecergasan fizikal iaitu ujian duduk dan jangkau, garu belakang , kekuatan genggaman tangan dominan, masa bangun dan jalan, duduk bangun kerusi 30 saat dan ujian jalan 2 minit (2MWT). Tidak terdapat perbezaan yang signifikan dalam profil sosiodemografi antara dua kumpulan. Ujian T tidak bersandar telah digunakan untuk membandingkan prestasi fizikal antara kumpulan penghidap dan bukan penghidap OA sendi lutut. Tiga belas peserta yang pernah jatuh serta merupakan penghidap OA sendi lutut (min umur = 70.92 ± 8.83 tahun) dan 20 peserta bukan penghidap OA sendi lutut (76.4 ± 7.92 tahun) telah menyertai kajian ini. Tiada perbezaan yang signifikan ($p > 0.05$) dalam prestasi fizikal bagi peserta yang pernah jatuh antara penghidap dan bukan penghidap OA sendi lutut. Walau demikian, terdapat 64% peserta yang menghidap OA sendi lutut tidak mencapai julat fleksibiliti otot peha (hamstring) yang normal berbanding 42% bagi peserta yang bukan menghidap OA sendi lutut. Prestasi fizikal bagi warga emas yang pernah jatuh antara penghidap dan bukan penghidap OA sendi lutut yang didiagnosis secara klinikal adalah sama. Oleh itu, rawatan fisioterapi untuk kedua-dua kumpulan mungkin sama dan berfokus pada kefungsian mobiliti, kecergasan kardiovaskular serta kekuatan bahagian bawah dan atas anggota badan. Di samping itu, untuk mengurangkan risiko jatuh dan meningkatkan prestasi fizikal, senaman regangan otot hamstring harus diberi penekanan dalam kalangan warga emas yang menghidap OA sendi lutut.

Kata kunci: Osteoarthritis sendi lutut; prestasi fizikal; jatuh; warga emas

INTRODUCTION

Osteoarthritis (OA) is the second largest cause of disability among older adults (Vos et al. 2012) with the knee being the joint to be most commonly affected (Ng & Tan 2013). In older adults, knee OA causes pain that leads to the deterioration of lower limb movement and physical performance (Edwards et al. 2014; Holla et al. 2015; Ng & Tan 2013).

Individuals with knee OA present with reduced handgrip and lower limb muscle strength (Costa et al. 2010; Osaki et al. 2012; Wen et al. 2016). In a local study, adults with knee OA highlighted that it affected their activities of daily living (Ahmad et al. 2018). Knee OA leads to balance impairment in older adults (Hatfield et al. 2013). Individuals with obesity who presented with knee OA had declined endurance compared to healthy individuals without knee OA (Sutbeyaz et al. 2007). In addition, older adults with knee OA have reduced hamstring flexibility leading to functional limitation (Onigbinde et al. 2013). However, the contrary was reported by Shirazi et al. (2016).

Knee OA has been reported to be correlated with an increased risk of falls (Dore et al. 2015; Lastrucci et al. 2017; Smith et al. 2016). According to Ng & Tan (2013), consequences of falls includes declined health status and quality of life (Roe et al. 2009; Singh et al. 2018). Among older adults with knee OA, the risk of falls increases with declined physical performance (Mat et al. 2015) such as reduced balance and muscle strength (de Zwart et al. 2015; Hill et al. 2012; Khalaj et al. 2014). Also, fallers with knee OA presented with declined functional mobility, measured using the timed up and go and gait speed tests (Alencar et al. 2007, Karapinar et al. 2017).

However, detailed information about physical performance, especially on flexibility and endurance in older adult fallers with knee OA is limited. It is essential to provide in depth information on physical performance in older adult fallers with knee OA due to increasing number of older adults, impact of falls and OA. This knowledge is important for physiotherapists when tailoring interventions specifically for older adult fallers with knee OA. In this study, we compared physical performance (that includes endurance, flexibility, lower and upper limb muscle strength) in older adult fallers with and without knee OA.

EXPERIMENTAL METHODS

Sample size calculation using G*Power 3.0.10 yielded a total of 44 respondents. Means and standard deviations from the study by Alencar et al. (2007) with alpha = 0.05 and power = 0.80 was used. However, in this preliminary cross sectional study, only 33 fallers (13 with knee OA and 20 without knee OA) were involved. Upon obtaining ethical approval from Research and Ethics Committee of UKM (UKM PPI/111/8/JEP 2018 240) and University of Malaya (20147-390) participants were recruited via convenient sampling from two urban cities (Kuala Lumpur and Petaling Jaya). The inclusion criteria for the fallers with knee OA group were (1) the participants were ged 60 and above; (2) they had been clinically diagnosed with knee OA (using the National Institute of Health and Care Excellence Guidelines, NICE 2014: had activity-related joint pain and no joint-related morning stiffness that lasted more than 30 minutes) and (3) had at least a fall in the past 12 months. Fallers without knee OA had to meet criteria (1) and (3) but not (2). Participants were excluded if they had: systemic rheumatic disease, gout, hip or knee replacement, plans of arthroplasty within the next 3 months, knee ligament or meniscus injury in previous years, severe physical disabilities (unable to walk even with a walking aid), participated in another OA-related or lifestyle interventional studies, been hospitalized recently for cardiovascular events, presented with neurological disease such as Parkinson disease or stroke, unstable cardiovascular disease, moderate and severe cognitive impairment assessed using Visual Cognitve Assessment Tool (VCAT) with score equal or less than 18 points, clinically diagnosed dementia, depression assessed using Geriatric Depression Scale (GDS) with score equal or more than 5 and blindness. Prior to data collection, informed written consent was obtained from all participants. Final year physiotherapy undergraduates under the supervision of a qualified physiotherapist performed the screening and measurements that took approximately an hour to complete with 5-minute rest in between tests. Participants were screened using the following;

Geriatric Depression Scale (GDS) GDS determines depressive symptoms (Nyunt et al. 2009). It has an intra-rater reliability with ICC 0.83 and inter-rater reliability with ICC 0.94 (Nyunt et al. 2009). It consists of 15 items. Scores of 0-4 indicates no presence of depressive symptoms, scores 5-8, 9-11 and 12-15 indicates mild, moderate and severe depression respectively.

Visual Cognitive Assessment Test (VCAT) VCAT was utilised to assess cognitive impairment (Kandiah et al. 2015). It consists of 16 items covering domains of episodic memory, executive function, visuospatial function, language and attention. It has 85.6% sensitivity and 81.1% specificity to diagnose cognitive impairment and dementia (Kandiah et al. 2015). The scale ranges from 0 to 30 with score 23-30, 18-22 and 0-17 indicating normal cognition, mild cognitive impairment and presence of dementia respectively.

Functional Fitness MOT (FFMOT) was used to measure physical performance (Jong et al. 2016; BHF National Centre for Physical Activity and Health, 2014). It consists of six physical performance tests and participants performed each test with 5 minutes of rest in between. The 6 physical performance tests are:

Chair Sit and Reach Test Chair sit and reach test was used to measure lower limb flexibility in older adults (Jones

et al. 1998). It has good intraclass test-retest reliability with $r = 0.92$ for men and $r = 0.96$ for women. (Jones et.al. 1998). Participants were seated at the edge of a chair which was placed against the wall. One foot was placed flat on the floor and the other leg with the knee extended and ankle in 90°dorsiflexion. Participants reached forward by sliding their hand towards their knee which was maintained in full extension. Participants maintained the position for 2 seconds with the spine straight and head in normal alignment. Distance from the tip of the middle finger to the tip of the middle toe was measured and recorded. A positive value "+" indicated that the fingers crossed the toe line, a negative "-" value indicated that the fingers did not cross the toe line. A trial session was allowed.

The Back Scratch Test The back scratch test was used to test upper body and shoulder flexibility (Rikli & Jones 1999a). Participants were asked to maintain their back straight in a standing position. Participants who had balance impairment in standing were allowed to perform the test in seated position. One hand was placed behind the back and head over the shoulder with palm facing the body and pointing downwards. The opposite hand was placed behind the back with palm facing outwards and pointing upward. Participants were instructed to bring both hands to touch or overlap the middle fingers of each hand. The distance of overlap or distance between the tips of middle fingers was measured and recorded to nearest cm. The distance measured from the tip of the middle fingers touching was considered "0". Overlapping was considered "+" and not touching "-". A trial was allowed. Back Scratch test has high test-retest reliability with $r = .98$ (Miotto et al. 1999).

Handgrip Strength Dominant handgrip strength test was used to measure hand grip strength. It is used as an indicator for overall muscle strength in older adults (Rantanen et al. 2003). This test has high intra and inter-tester reliability with Pearson correlation coefficient > 0.8 (Wind et al. 2010) and strongly correlates with total muscle strength, correlation coefficients between 0.74 and 0.89 (Wind et al. 2010). Handheld dynamometer (Lafayette Instrument Company, USA) was used for this test. Participants performed the test in sitting position with feet placed flat on the floor, shoulder in neutral, arms unsupported, elbows flexed at 90 degrees, forearm in neutral position, wrist 0-30 degrees extended and 0-15 degrees ulnar deviated (Ashton & Myers 2003). Participants were instructed to grip the dynamometer as hard as they could for 5 seconds. The test was performed three times and the highest score was taken as the result (Abizanda et al. 2012).

Timed Up and Go (TUG) Test Timed up and go test (TUG) was used to assess functional mobility (Podsiadlo & Richardson 1991) and to determine risk of falls (Rolenz & Reneker 2016). TUG has been reported to have 64% sensitivity and 75.7% of specificity in identifying fall risks (Rolenz & Reneker 2016). Participants were seated with feet flat on the floor and hands on the thighs. They were instructed to walk (using normal footwear) on a marked three meter pathway at a safe and comfortable pace, return back to the intial position and sit down. The time taken for the participants to get up, walk and return back to sitting was recorded in seconds. Usage of walking aid was allowed and it was documented. The test was performed twice and the average of the two test was used as the result.

30 Seconds Chair Stand The 30 seconds chair stand was used to determine lower limb muscle strength (Jones et al. 1999). This test has a high intra-rater reliability (ICC 0.97-0.98) and high inter-rater reliability (ICC 0.93-0.98) (Gill & McBurney 2008). A straight back chair with no armrest was placed against a wall. Participants sat on the chair with arms folded across the chest and with feet flat on the floor. Participants were instructed to stand and return to sitting as many times as possible within 30 seconds. The number of stands in 30 seconds were recorded. This test has a high intra-rater reliability (ICC 0.97-0.98) and high inter-rater reliability (ICC 0.93-0.98) (Gill & McBurney 2008).

2-Minute Walk Test The 2-min walk test was used to measure cardiovascular endurance in older adults (Connelly et al. 2009) and was performed to replace 6 min walk test (6MWT) in our present study. This test has excellent test–retest reliability in older adults with ICC 0.95 with excellent correlation with 6MWT ($r = 0.93$) (Connelly et al. 2009). Participants were asked to walk as far a distance as possible in 2 minutes. Blood pressure, SpO2 and Borg score were obtained every one minute. The distance completed in 2 minutes were measured in meters. Participants were allowed to use walking aids if already using one.

Modified Baecke Physical Activity Questionnaire Modified Baecke Physical Activity questionnaire measures habitual physical activity among older adults (Voorrips et al. 1991). It consists of items about household, sport and leisure time activities. The total sum of 3 items provides the overall activity score. This questionnaire was reported to have good repeatability with test-retest correlation between 0.65 and 0.89 (Pols et al. 1995). Modified Baecke Physical Activity questionnaire also correlates with physical activity ratio (PAR), correlation coefficient = 0.54, in which PAR is the ratio of total energy expenditure and resting metobilic rate (Hertogh et al. 2008).

Short Activity-Specific Balance Confidence Test (ABC-6) Scale ABC-6 was used to assess the fear of falls (Peretz et al. 2006). It has good to excellent test-retest reliability (Schepens et al. 2010). Items are rated on a rating scale that ranges from 0 – 100, in which score of 0 represents no confidence and 100 represents complete confidence.

Knee Injury and Osteoarthritis Outcome Score (KOOS) KOOS was only administered among older adults with knee OA. It was used to determine individual's opinion on knee injury and associated problems (Roos & Toksvig-Larsen 2003). It has a high test-retest reliability with ICC = 0.75 for all subscales. There are 42 items, divided into 5 subscales which are pain, symptoms, activity of daily living (ADL) function, sport and recreational function and quality of life. The score given ranged between 0 to 100, with 0 representing extreme knee problems and 100 representing no knee problems.

DATA ANALYSIS

IBM SPSS Statistics version 23 (IBM, New York) was used for all statistical analysis. Shapiro-Wilks test, Kurtosis ratio and Skewness ratio were used to determine normality of the data. The sociodemographic data was examined using descriptive analysis. Physical performance scores of participants were compared with the norm from previous studies (Bohanon et al. 2015; Ibrahim et al. 2017; Lam et al. 2016; Rikli & Jones 1999). Independent T-test and Chi-Square was used to compare physical performance between older adults with and without knee OA.

RESULTS

Shapiro-Wilks test, Skewness ratio and graphical representation were checked to determine the normality of the data. Table 1 shows the sociodemographic characteristics of the participants. Majority of the participants were females, had moderate physical activity levels and their body mass index (BMI) were normal. Older adult fallers with knee OA had all the KOOS subscale score of more than 50%, in which the higher percentage indicates lesser knee problem.

TABLE 1. Sociodemographic characteristics of participants

Characteristics	Total
Age (years), $\bar{x}$ ± s.d.	74.24 ± 8.60 years
Gender, n (%)	
Male	10 (29.4)
Female	23 (67.6)
BMI (kg/m^2), n (%)	
Underweight	4 (12.1)
Normal	21 (63.6)
Overweight	7 (21.2)
Obese	1 (3.0)
Educational level, n (%)	
Primary	1 (30)
Secondary	18 (54.5)
Tertiary	14 (42.4)
Number of medications, n (%)	
0-3	17 (51.5)
≥ 4	16 (48.5)
Number of co-morbidities, n (%)	
0-1	9 (27.3)
≥ 2	24 (72.7)
Number of falls, n (%)	
1	14 (42.4)
≥ 2	19 (57.6)
Modified Baecke Physical activity level (scores), $\bar{x}$ ± s.d.	6.52 ± 1.70
Activity balance confidence (% score), $\bar{x}$ ± s.d.	57.76 ± 25.87
Category of participants, n (%)	
Knee OA	13 (38.2)
Without Knee OA	20 (58.8)

Notes: $\bar{x}$ = mean; s.d. = standard deviation; n = frequency; BMI = body mass index; ADL = activities of daily living; QOL = quality of life

Table 2 displays the sociodemographic characteristics and physical performance comparison between older adult fallers with and without knee OA. No significant differences in physical performance between these two groups were recorded ($p > 0.05$). The effect size of all variables were small (< 0.5), except age which was of moderate effect size (> 0.5).

Figure 1 illustrates the comparison of participants with and without knee OA that were not within the norms of physical performance based on age and gender. Although there were no siginificant differences between the two groups pertaining physical performance norms ($p > 0.05$), almost 64% fallers with knee OA did not meet the lower limb flexibility (chair sit and reach test) norms compared to only 42% fallers without knee OA.

DISCUSSION

The objective of our present study was to compare physical performance between older adult fallers with and without knee OA. Physical performance between fallers with and without knee OA were similar.

TABLE 2. Comparison of sociodemographic characteristics and physical performance between older adult fallers with and without knee OA

Variables (n = 20)	Fallers without knee OA (n = 13)	Fallers with knee OA	*p* value	Effect size
Age (years), $\bar{x} \pm$ s.d.	76.40 ± 7.92	70.92 ± 8.83	0.73[a]	0.65[d]
Gender, n (%)				
Male	9 (45)	1 (7.7)	0.02[b]	0.30[phi]
Female	11 (55)	12 (92.3)		
BMI (kg/m^2), n (%)				
< 18.5	2 (10.5)	2 (14.3)	0.346[b]	0.25[v]
18.5 – 24.9	14 (73.7)	7 (50.0)		
> 25.0	3 (15.8)	5 (35.7)		
Educational level, n (%)				
School level	10 (30.3)	9 (27.3)	0.37[b]	0.12[phi]
Higher education	9 (27.3)	5 (15.2)		
Number of medications, n (%)				
0-3	8 (40)	8 (61.5)	0.23[b]	0.39[phi]
≥ 4	12 (60)	5 (38.5)		
Number of co-morbidities, n (%)				
0-1	6 (30)	3 (23.1)	0.66[b]	0.16[phi]
≥ 2	14 (70)			
Number of fall, n (%)				
1	9 (47.4)	5 (35.7)	0.50[b]	0.31[phi]
≥ 2	10 (52.6)	9 (64.3)		
Activity balance confidence (%), $\bar{x} \pm$ s.d.	54.66 ± 27.8	62.52 ± 22.81	0.40[a]	0.31[d]
Modified Baecke Physical activity level (scores), $\bar{x} \pm$ s.d.	6.32 ± 1.60	6.84 ± 1.87	0.39[a]	0.30[d]
Physical performance test, $\bar{x} \pm$ s.d.				
30s Sit to stand test (s)	9.30 ± 6.07	10.92 ± 3.57	0.39[a]	0.33[d]
Dominant handgrip strength test (kg)	20.46 ± 8.23	18.74 ± 4.16	0.23[a]	0.26[d]
Chair sit and reach test (mm)	30.25 ± 154.83	8.31 ± 150.80	0.67[a]	0.14[d]
Backscratch test (mm)	-66.11 ± 137.48	-58.96 ± 122.78	0.20[a]	0.05[d]
Timed up and go test (s)	13.26 ± 9.18	10.05 ± 3.35	0.07[a]	0.46[d]
KOOS score (%), $\bar{x} \pm$ s.d.				
Symptoms		74.45 ± 18.61		
Pain		84.62 ± 9.39		
ADL		83.71 ± 13.95		
Sport and recreational activities		54.23 ± 32.78		
QOL		62.98 ± 22.31		

$\bar{x}$ = mean; s.d. = standard deviation; n = frequency; BMI = body mass index; a = independent t test; b = chi square test; d = Cohen's d; v = Cramer's v; phi = phi coefficient

Our findings are contradictory to previous studies. The probable reason for this may be the difference in the severity of knee OA among participants between studies. For instance, the study by Khalaj et al. (2014) reported significant difference in physical performance between groups with and without knee OA. It is noteworthy that participants in the study by Khalaj et al. (2014) were diagnosed with severe knee OA while that was not the case in our study. In our present study, diagnosis of knee OA was made based on NICE (2014) guidelines.

Moreover, majority of fallers in our study were females. It is argued that women generally have better health seeking behaviours compared to men (Thompson et al. 2016). Hence, older adult fallers with knee OA in our study could have taken corrective actions for their problems. It is known that higher physical activity levels are associated with higher physical performance status (Moreno et al. 2014). In our present study, both the groups had similar physical activity levels and this could be another reason for the non significant difference of physical performance between the groups.

Regarding lower limb flexibility, more fallers with knee OA did not meet the sit and reach test norm compared to older adult fallers without knee OA. Similarly, hamstring flexibility was found to be significantly lower in older adults with knee OA when measured using modified sit and reach test in an earlier study (Onigbinde et al. 2013). In contrast, hamstring flexibility did not differ significantly between groups during passive knee extension (Shirazi et al. 2016). This may be explained by the different tests used in these studies. During sit and reach test as in our study, posterior thigh muscles that include hamstring and calf muscles could be in tension, preventing hamstring being stretched maximally due to discomfort in calf muscles which could have affected the results (Kawano et al. 2010). Furthermore, sit and reach test involves multiple joints including ankle and knee joints (Mayorga-vega et al. 2014). Therefore, presence of any impairment in the involved joints could have contributed in poor reaching performance of our study participants.

Coherent with past study, a large percentage of older adults from both groups did not meet the physical performance norms (Chen et al. 2018) indicating reduced functional mobility, endurance, lower and upper limb muscle strength. Older adult fallers have been reported to experience decline in physical performances regardless of existing medical illnesses (Boye et al. 2015). Exercises have been shown to improve functional outcomes in older adults (Gine-Garriga et al. 2014) especially with progressive strength training (Henwood & Taaffe 2004).

We have provided comprehensive information on physical performance tests that included strength, flexibility, balance, mobility and cardiovascular fitness among fallers with and without knee OA. However, we failed to obtain the required sample size. Power computed from post hoc analysis was 0.7 which indicates inadequate sample size. Ideal power for sample size has been reported to be at least 0.8 (Suresh & Chandrashekara 2012). Lastly, participants were recruited only from two urban cities, thus the findings may not be generalized to all older adults. Future studies are required with a larger sample size and from both urban and rural cities to represent community dwelling older adults in Malaysia.

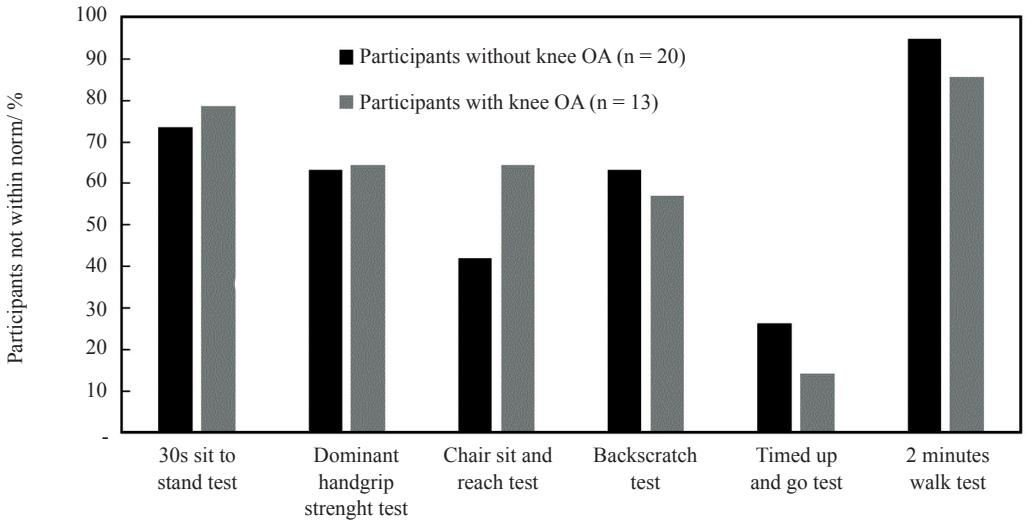

FIGURE 1. Differences in percentage of participants with and without knee OA that are not within norm of physical performance test

CONCLUSION

Our study results showed that physical performance between fallers with and without clinically diagnosed knee OA were the same. Hence, similar interventions that comprises of functional mobility, endurance, lower and upper limb strength training should be prescribed to both these groups. Morever, lower limb flexibility should be emphasised in the exercise regimes to fallers with clinically diagnosed knee OA in the prevention of falls and further decline in physical performance.

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